

LIBBY

- *Reservoir Uses:*
 - Authorized uses include flood control, hydropower, recreation, water quality, and fish and wildlife.
 - Operating range: 2287 to 2459 feet
- *Before the ESA listings Libby operated for multiple uses:*
 - The end of December operation typically was below elevation 2363 feet and continued to draft for power by end of April. The end of December rule curve is 2411 feet.
 - The project reduced outflow to minimum outflow in May and June to refill.
 - Summer draft by end of August was limited to five or ten feet to benefit recreation.
 - Fall was operated for power drafts.
 - Project would power peak with daily and hourly load following.
 - Flood control and power operations coordinated with Canada per the Columbia River Treaty.
- *Changes which have been made to benefit fish since ESA listing:*
 - Operate to variable end of December flood control elevations. In below average water years the end of December flood control elevation may be higher than elevation 2411 feet. Operating to the higher elevation increases the likelihood of refilling to April 10 VARQ flood control and meeting the spring sturgeon and refill operations that follow.
 - Interim implementation of VARQ (variable flow) flood control, which is a higher flood control elevation in January through April in average to below average water years. The goal is to have more water available for sturgeon operations and enhance the likelihood of refill by June 30 to provide salmon flow augmentation.
 - Have a 75% confidence of reaching April 10 flood control rule curve elevation.
 - From April 10 through June 30, provide flows and temperature releases to meet the needs of listed white sturgeon in the Kootenai River downstream of Libby, while refilling June 30.
 - Provide for bull trout minimum flows and limited ramping rates.
 - Draft 20 feet to elevation 2439 feet by August 31 for salmon flow augmentation. The 20-foot draft limit was adopted in consideration of resident fish needs in the reservoir.
- *Variations to recommended operations include the Montana proposal for summer draft to 10 feet (elevation 2449 feet) in most water years, and dry years draft 20 feet to elevation 2439 feet by end of September.*
 - In 2004 a modified version of the Montanan plan was implemented. Libby released steady outflow from late June through mid-September. Libby refilled to only nine feet from full (elevation 2450 feet), and drafted only 15 feet end of August to elevation 2445 feet and elevation 2447 feet end of September.

FOR DISCUSSION PURPOSES ONLY

VI. Discussion of Columbia and Snake River Flow Operations by Reservoir

HUNGRY HORSE

- *Reservoir uses:*
 - Authorized for flood control, hydropower, irrigation, navigation and regulating flow in the S.F. Flathead River.
- *Before the ESA listings, Hungry Horse was operated primarily for power and flood control (Operating range 336 to 3560 feet)*
 - Operated in fall and winter for deep power drafts (frequent refill failure)
 - Project minimum discharge was 145 cfs
 - Limited summer drafted (about 4 feet during July and August)
 - Peaking power operations – no limits
 - Daily draft limit of 1.5 feet per day for bank stability*
- *Changes which have been made since ESA listing to benefit fish:*
 - Limit power drafts
 - Implementation of VARQ Flood Control (interim)
 - Attempt to meet April 10 flood control
 - Operate to refill on or about June 30
 - Draft to elevation 3540 feet by August 31 to supplement summer flows in the mainstem of the Columbia River.
 - Existing draft limit to 3540 feet the end of August was adopted for resident fish needs
 - Meet established minimum flows on Flathead Rivers at Columbia Falls and in the South Fork of the Flathead River below the dam (3,200 – 3,500 cfs at Columbia Falls and 400 – 900 cfs from the dam)
 - Limited hourly and daily flow changes
 - Temperature – Use of a selective withdrawal system to provide warmer outflows to benefit resident fish in the Flathead River June 1 through September 30
 - Do not exceed the 110% TDG level established by the state of Montana
- *Variations to recommended operations include the Montana proposal to draft 10 feet from full pool (elevation 3550 feet) by the end of September in all years except the lowest 20th percentile water supply (drought years) when the draft limit is increased to 20 feet from full pool by end of September.*

*Informal

COLUMBIA RIVER TREATY

- *History:*
 - The Columbia River Treaty (Treaty) is an agreement between Canada and the U.S. which authorized the construction and operation of 4 storage dams: Mica, Keenleyside, and Duncan Dams in Canada and Libby Dam in the U.S. The Treaty authorized 15.5 Maf of storage in Canada.
 - Signed in 1961 and ratified in 1964
- *Purposes:*
 - Flood Control
 - Power
- *Entities:*
 - Canadian Entity is B.C. Hydro
 - U.S. Entity is shared between BPA Administrator and the USACE Northwestern Division Engineer
- *Treaty Planning Studies:*
 - AOP – Assured Operating Plan is completed 6 years in advance. Designed to achieve an optimum power and flood control operation in both countries.
 - DDPB – Determination of Downstream Power Benefits is completed 6 years in advance. Calculates the Canadian Entitlement, which is a portion of the calculated power generated in the U.S. from water released from Canada.
 - DOP – Detailed Operating Plan is done each year and includes detailed procedures for implementing the AOP. If Entities agree, mutually beneficial changes to the AOP for power production or flood control purposes can be incorporated in the DOP. Changes for other purposes, though mutually beneficial, may be handled via the Supplemental Operating Agreements described below.
- *Supplemental Operating Agreements:*
 - Must be mutually beneficial for both Entities to agree to them. The benefits may be to power or flood control. In some cases the benefits are environmental, including environmental benefits in Canada.
 - There may be three operating agreements per year. Examples of agreements that are discussed every year include providing 1 Maf of flow augmentation and Vernita Bar minimum flows in the U.S. in return for meeting Canadian power and non-power objectives (i.e. trout and white fish spawning flows and dust storm avoidance).
- *Flood Control Benefits:*
 - Treaty required Canada to operate at least 8.45 Maf of storage to minimize flood damages in both nations.
 - On-Call Storage - In a major flood event, if the U.S. projects are unable to regulate flows at The Dalles to less than 600 kcfs, the U.S. can request that all Canadian storage is evacuated more in January through April at a cost of \$1.875 million.

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Although 1997 was a water year where on-call storage may have been considered, this option has never been used.

- *Power Benefits:*
 - The operation of Canadian Treaty storage creates hydropower benefits in both Canada and the U.S. through at-site generation, reduced spill, and the supplementing of flows using storage releases.
 - U.S. downstream power benefits must be shared equally.
- *Non-Treaty Storage:*
 - Canada elected to build Mica Dam higher than required by the Treaty which enabled an additional 5 Maf of non-Treaty storage via an agreement separately negotiated between BC Hydro and BPA that gave each rights to operate half of the storage.
 - The last non-Treaty Storage Agreement expired in June 2004.

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GRAND COULEE

- *Reservoir Uses:*
 - Authorized purposes include flood control, hydropower, irrigation, and navigation.
- *Before the ESA listings, Grand Coulee was operated for irrigation, power and flood control* (Operating range 1208 to 1290 feet)
 - Deep power drafts of FDR in late fall, winter and early spring
 - 1256 feet maximum elevation to perform drum gate maintenance (normally performed during flood control drawdown if elevation allows; required at least every three years).
 - Daily draft limits for land stability in FDR (varies with elevation)
 - Be at or below flood control elevation on April 30
 - Be at or above 1240 feet in GCL by the end of May and through the irrigation season for pumping to Banks Lake
 - Be above 1265 by June 1 and fill to 1290 on or about July 1.
 - Existing draft limits of 1280 and 1278 feet was adopted for resident fish needs.
 - 1287-1289 preferred elevation for summer recreation on FDR – Lake Roosevelt National Recreation Area – limits exposure of tribal cultural resource and historic site.
 - Maintain FDR about 1278 during summer to limit adverse impact to tribal Roosevelt Recreation Enterprises National Park Service concessionaires' houseboat operations (such as Kettle Falls Marina).
 - Hourly, daily, weekly and seasonal power production.
- *Changes which have been made to benefit fish since ESA listing:*
 - Meet chum flows below Bonneville Dam
 - Release water for Vernita Bar (Fall Chinook) protection
 - Limit power drafts
 - Operate to be at/or near April 10 flood control
 - Minimize time below 1225 (Inchelium Ferry)
 - Operate to help meet spring flow targets
 - Participate in the Columbia River System spill priority list
 - Minimize spill when FDR is below 1260 to keep TDG as low as possible. Shift as much spill as possible to Chief Joseph
 - Working with Corps to modify Chief Joseph spillway to allow spill at Chief Joseph and generation at Grand Coulee to reduce TDG in Columbia River during spill conditions
 - Refill on or about June 30
 - Draft to elevation 1280 (or 1278 in dry years) end of August for Lower Columbia River summer flow augmentation
 - Be at or above 1283 by September 30 (following meeting August 31 requirements)

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BANKS LAKE

- *Reservoir Uses:*
 - Authorized use as storage and equalizing reservoir for irrigation water for Columbia Basin Project.
- *Before the ESA listings, Banks Lake was operated for strictly for irrigation and recreation (Operating range 1565 to 1570 feet)*
 - Operated between elevations 1567.5 and 1569.0 feet
 - Meet irrigation needs for Columbia Basin Project
 - Resident fish
 - Recreation
 - 1567.5 to 1569.0 preferred elevation for recreation
 - Cultural resources – keep elevation high to limit exposure of tribal cultural resource and historic sites. Sites are thought to be significantly older than those found in FDR. Sites have not been exposed to the annual cycle of drawdowns so are considered to be more vulnerable than those at FDR.
- *Changes which have been made to benefit fish since ESA listing:*
 - Allow Banks Lake elevation to drop to 1565.0 by end of August (5 feet from full) to help meet summer flow objectives
- *Studies which have been undertaken and their results:*
 - Banks Lake EIS – looked at an additional 5 feet of water from Banks. Significant impacts for very little benefit to anadromous fish so did not implement additional draft.

ALBENI FALLS

- *Reservoir Uses:*
 - Authorized uses include flood control, hydropower, navigation, recreation, water quality, and fish and wildlife.
 - Operating Range: 2051 to 2062.5 feet
- *Before the ESA listings, Albeni Falls operated for multiple uses:*
 - Lake Pend Oreille operated near full at elevation 2062.5 feet from late June through August for the benefit of recreation.
 - The lake began its winter draft in September.
 - Targeted a minimum pool level by November 15 per a 1991 request from Idaho Department of Fish and Game to protect kokanee spawning areas from wave damage.
 - Typically Lake Pend Oreille drafted to elevation 2051 feet by November 20 for flood control and power and operated between elevation 2051 and 2052 through March, when spring refill began.
- *Changes which have been made to benefit fish since ESA listings:*
 - Lake Pend Oreille operated near full at elevation 2062.5 feet from late June through August.
 - The lake began its winter draft in September.
 - Draft to the winter lake elevations by mid-November.
 - Minimum winter lake elevations have varied over the past years to study the effects of wave action along the shoreline on spawning gravel and the resultant kokanee production as forage for listed bull trout.
 - There were several consecutive years where Lake Pend Oreille drafted to elevation 2055 feet by November 20 and operated between elevation 2055 and 2056 through March, when spring refill began. The higher elevation was to study whether there were better kokanee spawning areas at the higher elevation.
 - This was followed by testing for several years at alternating elevations of 2051 feet and 2055 feet. The test years included some years where the winter lake elevation was 2053 feet.
 - NOAA Fisheries recommended operation was 2051 feet to provide additional water for chum flow in the fall.

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UPPER SNAKE

This sheet describes how Reclamation provides up to 487,000 acre-feet (AF) of water annually for salmon; this is called flow augmentation. Flow augmentation is intended to support juvenile salmonid migration between April 10 and August 31. The amount of water available each year varies depending upon factors such as the amount of natural water supply available to fill Reclamation storage reservoirs and numbers of willing sellers.

Factors in acquiring water

- Must comply with state water law and rules, and rental pool procedures
- Must be consistent with the Nez Perce Agreement
 - Can only purchase up to 427 kaf from storage sources, including water available from Oregon natural flows
 - May rent or acquire additional 60,000 acre-feet of natural flow from Idaho; natural flows either:
 - Help meet 427 kaf, when less than 427 kaf is available from storage and Oregon
 - Be provided on top of 427 kaf, when a full 427 kaf is available from storage and Oregon
 - Of the 60 kaf of natural flows, about 48 kaf is credited towards flow augmentation; the balance is provided before and after the April 10-August 31 flow augmentation period
 - Amount that Reclamation pays for stored water are specified in the Nez Perce Settlement
- Sellers must be willing parties (state law and policy)

Sources of water for flow augmentation

- Uncontracted space – space in Reclamation reservoirs
 - Reliable source of water in most years
 - Not sufficient to meet all flow augmentation needs
 - Reservoirs upstream of Milner Dam
 - 22,896 AF reservoir space
 - Boise Basin
 - 3,554 AF (uncontracted space)
 - 37,378 AF (reacquired space)
 - Payette Basin
 - 95,000 AF (69,900 Lake Cascade + 25,400 Deadwood Reservoir)
- Rental pools
 - Contractors annually assign water to water banks
 - Reclamation annually rents water available for flow augmentation

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- Natural Flows
 - Malheur River Basin (Oregon)
 - Reclamation permanently acquired 17,649 AF
 - Snake River below Milner Dam
 - High Lift Pumpers 60,000 AF per Nez Perce agreement, of which about 48 kaf may be counted toward flow augmentation
 - Idaho bought out non-Reclamation irrigation project, Reclamation has leased for 30 years (all 60 kaf)
- Powerhead
 - Anderson Ranch Dam (37 kaf)
 - Palisades Reservoir (157.5 kaf)
 - Multiple constraints related to use of powerhead space.
 - Source of last resort
 - Only allowed to use this space if can not meet the 427 kaf. Can not use powerhead to meet 487 kaf.
 - Can only use 50% of power head space in any one year.
 - It becomes last of the last to fill.

Process to Obtain Augmentation water – Typically start in April

- Identify Potential Water Available
 - Last year's carryover
 - April 1 water supply forecast for current year
- Contact Water Users
 - Watermasters
 - Irrigation Districts
- If the 427 kaf is available
 - Write agreements with water suppliers
- If less than 427 kaf, look at other sources of water
 - Borrow from other sources (i.e. Irrigation Districts)
 - Power head
- Coordinate releases (June through August)

Other limitations that affect water availability

- Of the storage space in Reclamation reservoirs most is either
 - Under contract
 - Most are permanent repayment contracts in which the Contractors have paid for their share of the construction cost of the project
 - The Contractors are entitled to store and release water from their contracted space
 - Dedicated to conservation pool
 - Protect water quality
 - Provides minimum pools for resident fish – both listed and non-listed

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- Allocated for streamflow maintenance
 - Provides minimum flow below the dams during the winter months
- Unallocated and uncontracted and assigned to flow augmentation
- Reacquired for flow augmentation
- Water released for flow augmentation reduces volume of carryover storage at reservoirs – which can affect refill the following year

Typical reservoir release strategies for flow augmentation

- The strategy for releasing flow augmentation water depends on the volume of water available and the timing of the natural runoff. Reclamation strives to not release stored water for flow augmentation while the flow objectives at Lower Granite Dam are being met.
- Releases begin when flood control operations are completed in average or wet years and in dry years when there is no flood control operations releases typically begin on or after June 20
- Releases are set so that all is provided by August 31

Boise River Releases

- Lucky Peak Dam releases are limited by human safety and property damage issues
 - Restricted to about 400 cfs above irrigation releases
 - For public safety reasons, total flows (irrigation plus augmentation) cannot exceed 1,500 cfs through Boise

Payette River Releases

- Reclamation works with Payette River Watershed council
- Flow augmentation coordinated with multiple other uses
- Usually between 800-1500 cfs above irrigation releases

Snake River Releases above Milner Dam

- Flow augmentation releases made at Milner Dam through coordination of upriver reservoirs
- Augmentation will begin after maximum reservoir fill is achieved and after flood releases pass Milner dam
- Most years limited to 2,500 cfs past Milner Dam for flow augmentation but can release up to 3,000 cfs if necessary to get the water out by August 20
- Releases begin on or after June 20 and are usually complete by August 20
- Milner flow ramp up limited to 500 cfs per day; no hourly changes greater than 100 cfs
- Milner flow ramp down limited to 100 cfs per day
- In an interim agreement during license renewals for its Hells Canyon reservoirs, Idaho Power agreed to shape these releases, subject to a \$2 million annual cost cap (to be absorbed by IPC) for
 - Shaping of Reclamation's above Milner flow augmentation releases, and
 - Release of 237 kaf from Brownlee Reservoir beginning in late June

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Travel Time (National Weather Service-River Forecast Center)	
Reach	Days
Upper Snake River (American Falls to Brownlee)	6
Boise River (Lucky Peak to Brownlee)	2
Payette River (Cascade/Deadwood to Brownlee)	2
Lower Snake River (Brownlee to Lower Granite)	1

DWORSHAK

- *Reservoir Uses:*
 - Authorized uses include flood control, hydropower, navigation, recreation, water quality, and fish and wildlife.
 - Operating Range: 1445 to 1600 feet
- *Before the ESA listings, Dworshak operated for multiple uses:*
 - The end of December operation typically was below elevation 1525 feet and continued to draft for power by end of April.
 - The project then reduced outflow to minimum outflow in May and June to refill.
 - Summer draft by end of August was limited to five to ten feet for the benefit of navigation and recreation.
 - Fall operation included up to 45 days of steady operation to enhance downstream steelhead fishing. The remainder of the fall was operated for power drafts.
 - Selector gates were operated for temperature control at the downstream hatchery. From January through April selector gates were operated to limit kokanee entrainment.
- *Changes which have been made to benefit fish since ESA listing:*
 - From September through April 10 operate Dworshak on minimum outflow or to refill to flood control April 10
 - Attempt to be at flood control rule curve on April 10.
 - Release flow from Dworshak to augment flow at Lower Granite from April 10 through June 30 while also attempting to refill by June 30.
 - July, begin draft of 80 feet to elevation 1520 feet by August 31 to augment flow and provide cool water to moderate temperatures in the lower Snake River.
 - The 80 foot draft limit was developed to help assure the reservoir's ability to refill to April 10 flood control rule curve in the following year.
 - Through winter months, inflow to the reservoir is often less than project minimum outflow, and the reservoir is unable to refill to April 10 flood control in low water years, even though the project is releasing minimum outflow.
 - The 2000 NOAA BiOp recommended evaluating a draft to elevation 1500 feet by August 31 for salmon flow augmentation; however, because of concerns for cultural resource sites and reduced probability for reaching April 10 refill, this action was not carried forward in the 2004 UPA.
 - Based on an Agreement between the Nez Perce Tribe and the United States, which provides for the Tribe's annual use of 200 kaf, generally described as the water stored between elevation 1535 and 1520, the draft of 80 feet may be extended from July 1 into September (rather than August 31) to enhance environmental conditions in the lower Snake River.

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